U.S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: *Eurycea chisholmensis*

COMMON NAME: Salado salamander

LEAD REGION: Region 2

INFORMATION CURRENT AS OF: October 2005

STATUS/ACTION:

___ Species assessment - determined species did not meet the definition of endangered or threatened under the Act and, therefore, was not elevated to Candidate status
___ New candidate
_X_ Continuing candidate
___Non-petitioned
_X_ Petitioned - Date petition received: May 11, 2004
__ 90-day positive - FR date:
__ 12-month warranted but precluded - FR date:
_N_ Did the petition requesting a reclassification of a listed species?

FOR PETITIONED CANDIDATE SPECIES:
a. Is listing warranted (if yes, see summary of threats below)? Yes
b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? Yes
c. If the answer to a. and b. is "yes", provide an explanation of why the action is precluded.
During the past 12 months, almost our entire national listing budget has been consumed by work on various listing actions to comply with court orders and court-approved settlement agreements, emergency listings, and essential litigation-related, administrative, and program management functions. We will continue to monitor the status of this species as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures. For information on listing actions taken over the 12 months, see the discussion of "Progress on Revising the Lists," in the current CNOR which can be viewed on our Internet website (http://endangered.fws.gov/).
___ Listing priority change
Former LP: ___
New LP: ___
Date when the species first became a Candidate (as currently defined): June 13, 2002

___ Candidate removal: Former LP: ___
___ A – Taxon is more abundant or widespread than previously believed or not subject to

the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.

___U – Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.

___ F – Range is no longer a U.S. territory.

___ I – Insufficient information exists on biological vulnerability and threats to support listing.

___ M – Taxon mistakenly included in past notice of review.

___ N – Taxon does not meet the Act's definition of "species."

___ X – Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Amphibian, Plethodontidae

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Texas

CURRENT STATES/ COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Bell County, Texas

LAND OWNERSHIP: Big Boiling Springs is located in a municipal park in Salado, Texas. Robertson Springs is on private property.

LEAD REGION CONTACT: Susan Jacobsen, 505-248-6641

LEAD FIELD OFFICE CONTACT: Austin Ecological Services Field Office, Paige Najvar, 512-490-0057

BIOLOGICAL INFORMATION:

Species Description: The Salado salamander is entirely aquatic and neotenic, meaning it does not metamorphose into a terrestrial adult. Adults are about 2 inches long. It has reduced eyes compared to other spring-dwelling *Eurycea* in north central Texas and lacks well-defined melanophores (cells containing brown or black pigments called melanin) and iridophores (cells filled with iridescent pigments called guanine). It has a relatively long and flat head and a blunt and rounded snout. Three pairs of reddish-brown to bright red gills are located on each side of the neck behind the jaws. The upper body is generally grayish-brown with a slight cinnamon tinge and an irregular pattern of tiny, light flecks. The underside is pale and translucent. The posterior portion of the tail generally has well-developed dorsal and ventral fins, although the dorsal tail fin may be absent (Chippindale et al. 2000).

Taxonomy: A description of the Salado salamander was published by Chippindale et al. (2000). The three known salamander species that occur in the northern segment of the Edwards Aquifer have very similar external morphology. Because of this, they were previously believed to be the same species; however, molecular evidence strongly suggests that there is a high level of divergence between the three groups (Price et al. 1994, Chippindale et al. 2000). All three of

these species, including the Salado salamander belong to the genus *Eurycea* within the Tribe Hemidactyliini. Tribe Hemidactyliini are characterized from other Tribes in Family Plethodontidae as having aquatic larvae. Plethodontid salamanders comprise the largest family of salamanders within the Order Caudata and are characterized by an absence of lungs (Petranka 1998).

Habitat/Distribution: Bell County has approximately fourteen very small (0.028 to 0.28 cubic feet per second (cfs)) to large (280 to 2,800 cfs) springs (Brune 1981). The Salado salamander is known historically from two spring sites near Salado, Bell County, Texas: Big Boiling Springs (also known as Main, Salado, or Siren Springs) and Robertson Springs (Chippindale et al. 2000). These springs bubble up through faults in the northern segment of Edwards Aquifer and associated limestones along Salado Creek (Brune 1975). Both are considered small to medium springs, depending on flow, by Brune's (1981) definition.

Population Estimates/Status: Salado salamanders have not been located in Big Boiling Springs, the type locality, since 1991 despite over 20 additional visits that occurred between 1991 and 1998 (Chippindale et al. 2000). Robertson Springs are on private land and access to the site has not been granted. The last survey at Robertson Springs was in the early 1990s.

Other spring sites may have Salado salamanders, but the Service has no confirmed information on other springs with salamanders. Four other spring sites (Dining Room, Elm or Critchfield, Benedict, and Anderson Springs) are within a mile of Big Boiling and Robertson Springs (Brune 1981). It is unknown if salamanders occur at these sites. Chippindale et al. (2000) reported that salamanders collected from the springs within Buttermilk Creek, which is near Salado Creek, may also be *E. chisholmensis*, but the specimens had not been identified when this paper went to press. The Service is still not aware of the species identification of the salamanders collected at this site.

THREATS

A. The present or threatened destruction, modification, or curtailment of its habitat or range. Primary threats include the chronic and catastrophic degradation of water quality and loss of adequate springflow at the spring sites that support the Salado salamander. The hydrologic connections between groundwater and surface water of the Northern Segment of the Edwards Aquifer are the ecological basis for maintaining adequate water quality for organisms that depend on the aquifer for survival, such as the Salado salamander. Most of the spring outlets in the City of Salado, including the type locality at Big Boiling Springs, have been modified during the past 150 years by dam construction in the mid-1800s, to supply power to various mills, and a stone wall to keep out cattle (Brune 1981).

In addition to direct habitat modification, urbanization also contributes to the threats to the Salado salamander by impairing water quality. Urbanization can dramatically alter the normal hydrologic regime and water quality of an area. Increases in impervious cover resulting from urbanization have been shown to cause measurable water quality degradation (Klein 1979, Bannerman et al.1993, CWP 2003). Impervious cover in a stream's watershed causes

streamflow to shift from predominantly baseflow, which is derived from natural filtration processes and discharges from local groundwater supplies, to predominantly stormwater runoff. Stormflows carry pollutants and contaminants into stream systems (Klein 1979, Bannerman et al. 1993, Schueler 1994, Barrett and Charbeneau 1996, Dartiguenave et al. 1997, CWP 2003). With increasing stormflows, the amount of baseflow available to sustain water supplies during drought cycles is diminished and the frequency and severity of flooding increases. The increased quantity and velocity of runoff increases erosion and streambank destabilization, which in turn leads to increased sediment loadings, channel widening, and detrimental changes in the morphology and aquatic ecology of the affected stream system (Hammer 1972, Booth 1990, Booth and Reinelt 1993, Scheuler 1994, Dartiguenave et al. 1997, Pizzuto et al. 2000, CWP 2003).

Even at relatively low levels of impervious cover, "profound and often irreversible impacts to the hydrology, morphology, water quality, habitat, and biodiversity of streams" can occur (Schueler 1994). Both nationally and locally, consistent relationships between impervious cover and water quality degradation have been documented. Increases in impervious cover exceeding 10 percent are associated with measurable water quality degradation, loss of sensitive aquatic organisms, reduction in stream biodiversity, stream warming, and channel instability within a watershed (Schueler 1994). Stream aquatic life problems such as loss of species diversity, malformations, and death have been identified in watersheds having impervious cover of at least 12 percent, with severe problems in watersheds with impervious cover greater than 30 percent. Generally, stream quality impairment can be prevented if watershed imperviousness does not exceed 15 percent and for more sensitive stream ecosystems watershed imperviousness should not exceed 10 percent (Klein 1979).

Although most of Bell County is still considered rural, population projections from the Texas State Data Center (2000) estimate that Bell County will increase in population by about 60 percent from 2000 (population 237,974) to 2040 (population 381,839). Interstate 35 runs through the City of Salado (population 3,475; Texas State Data Center 2000) and offers the perfect expansion corridor for increasing urbanization. Because the springs are located on either side of Interstate 35 (Brune 1981) and Big Boiling Springs is in the center of the city, increasing traffic and urbanization bring increasing risk of contamination spills and higher levels of impervious cover, and their subsequent impacts to the groundwater. Given the extremely limited known distribution of the Salado salamander, groundwater contamination is of great concern and may have already negatively affected the species.

Several groundwater contamination incidents have occurred within Salado salamander habitat (Price et al. 1994). Big Boiling Springs is located on the south bank of Salado Creek in a municipal park, near where past contamination events have occurred (Chippindale et al. 2000, Price et al. 1994). Between 1989 and 1993, at least four incidents occurred within a quarter mile from both spring sites, including a 700 gallon and 400 gallon gasoline spill and petroleum leaks from two underground storage tanks (Price et al. 1994).

B. Overutilization for commercial, recreational, scientific, or educational purposes. Not known to be a factor threatening the Salado salamander.

C. Disease or predation. Not known to be a factor threatening the Salado salamander.

D. The inadequacy of existing regulatory mechanisms. No Federal, State, or local laws provide for the protection of the Salado salamander. Senate Bill 1, passed by the Texas State Legislature in 1996, charges the thirteen regional water planning regions in the State to develop long-term plans for their water needs. The Brazos (Region G) Regional Water Plan (HDR Engineering, Inc. 2000) states that Bell County is one of 30 counties that has a projected water shortage in the next 50 years in one or more of the six water use categories (livestock, irrigation, mining, municipal, steam-electric, and manufacturing). The projected shortages for Bell County are in the municipal, manufacturing, and steam-electric categories. Senate Bill 1 states that future regulatory and financing decisions of the Texas Water Development Board and the Texas Commission on Environmental Quality need to be consistent with the approved regional plans.

Controls of nonpoint source pollution in the watershed are implemented through the Edwards Rules (water quality protection measures for the recharge and contributing zones of the Edwards Aquifer) adopted by the Texas Commission on Environmental Quality (TCEQ) in 1995 and 1997. Although implementation of the Edwards Rules in other areas of the Northern Segment of the Edwards Aquifer may have the potential to affect conditions at spring sites occupied by the Salado salamander, the jurisdiction of TCEQ does not extend into Bell County. For this reason, compliance of the Edwards Rules is not required in this part of the Edwards Aquifer.

To date, no comprehensive study has been conducted to evaluate the effectiveness of existing state and local regulations in protecting water quality and the aquatic organisms that depend on spring discharges from the Northern Segment of the Edwards Aquifer for survival. In addition, Chapter 245 of the Texas Local Government Code permits "grandfathering" of state regulations. Grandfathering allows developments to be exempted from new requirements for water quality controls and impervious cover limits providing that the developments were planned prior to the implementation of such regulations. However, these developments are still obligated to comply with regulations that were applicable at the time when project applications for development were first filed. The potential impact of the grandfathering statute as enacted by the State of Texas has not been examined with respect to existing regulations that protect water quality in the Edwards Aquifer region.

E. Other natural or manmade factors affecting its continued existence. The Salado salamander has a very limited distribution and appears to be highly sensitive to water quality and quantity degradation. Although no direct data have been collected on the Salado salamander's sensitivity to water quality, we believe that it is highly sensitive based on other amphibian research. Research indicates that amphibians, particularly their egg and larval stages, are sensitive to many pollutants, such as heavy metals; certain insecticides, particularly cyclodienes (endosulfan, endrin, toxaphene, and dieldrin), and certain organophosphates (parathion, malathion); nitrite; salts; and petroleum hydrocarbons (Harfenist et al. 1989). Because of their semipermeable skin, the development of their eggs and larvae in water, and their position in the food web, amphibians

can be exposed to waterborne and airborne pollutants in their breeding and foraging habitats. Toxic effects to amphibians from pollutants may be either lethal or sublethal, including morphological and developmental aberrations, lowered reproduction and survival, and changes in behavior and certain biochemical processes. Since the salamander is fully aquatic, there is no possibility for escape from contamination or other threats to its habitat. Crustaceans, particularly amphipods, on which the salamander feeds are especially sensitive to water pollution (Mayer and Ellersieck 1986; Phipps et al. 1995; Burton and Ingersoll 1994).

CONSERVATION MEASURES PLANNED OR IMPLEMENTED: There are currently no known conservation activities being planned or implemented for the Salado salamander.

SUMMARY OF THREATS: The primary threats facing the Salado salamander are the degradation of the quality and quantity of water that feeds the springs that support this species as a result of urban expansion over the watershed. The restricted range of the salamander makes it vulnerable to both acute and chronic groundwater contamination. The salamander is also vulnerable to catastrophic hazardous materials spills, increased water withdrawals from the Northern Segment of the Edwards Aquifer, and impacts to its surface habitat.

For species that are being removed from candidate status:

___Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions (PECE)?

RECOMMENDED CONSERVATION MEASURES: The Service recommends developing and implementing comprehensive regional plans to address water quality and quantity threats. A plan to protect or enhance water quality should include measures for projects constructed over contributing and recharge zones of the Northern Segment of the Edwards Aquifer. Such measures should include impervious cover limits, buffer zones for streams and other sensitive environmental features, low-impact developments, structural water quality controls and other strategies to reduce pollutant loads. Land preservation through acquisition, conservation easements, or deed restrictions also can provide permanent protection for water quality and quantity. Programs should be developed to reduce pollutant loading from already existing development and other potential sources of pollutants such as golf courses and transportation infrastructure. Partnerships should be formed with the landowners of the spring sites and efforts should be made to protect the surface habitat of the salamander. The Barton Springs Salamander Recovery Plan (USFWS 2005) outlines conservation measures in more detail. The measures set forth in this recovery plan were developed to protect another aquatic species in the Barton Springs Segment of the Edwards Aquifer, but many of these could be applied to the Salado salamander as well.

LISTING PRIORITY:

THREAT			
Magnitude	Immediacy	Taxonomy	Priority

High	**Imminent**	Monotypic genus	1
		Species	2*
		Subspecies/population	3
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/population	6
Moderate to Low	Imminent	Monotypic genus	7
		Species	8
		Subspecies/population	9
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

Rationale for listing priority number:

Magnitude: Limited distribution of this species makes it extremely vulnerable to extinction from degradation of water quality and water quantity.

Imminence: This species occurs in one of the most rapidly growing regions in the United States, making the loss of spring flow and degradation of water quality an imminent threat of total habitat loss. In fact, several contaminant spills have already occurred near both known locations for the Salado salamander. Also, the salamander hasn't been found at one of the two known locations since 1991 despite numerous attempts to find it.

_X_ Have you promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed? Yes.

Is Emergency Listing Warranted? There is not enough information to make this determination; also, there is not enough information on the Salado salamander to determine what protective measures could be put in place with an emergency listing to preclude its extinction.

DESCRIPTION OF MONITORING: The status of the Salado salamander was not actively monitored during the past year. We checked with the person most likely to be aware of any monitoring and verified that none has been conducted (Andy Price, TPWD, pers. comm. 2005).

COORDINATION WITH STATES: The Service coordinated with Texas Parks and Wildlife Department (TPWD). TPWD agreed that the Salado salamander should remain a candidate for listing.

LITERATURE CITED:

Arnold C.L. and C.J. Gibbons. 1996. Impervious surface coverage: the emergence of a key environmental indicator. Journal of the American Planning Association 62(2): 243-258.

Bannerman, R. T., D. W. Ownes, R.B. Dodds, and N. J. Hornewer. 1993. Sources of pollutants in Wisconsin stormwater. Water Science and Technology 28:241-259.

Barrett, M. E. and R. J. Charbeneau. 1996. A parsimonious model for simulation of flow and transport in a karst aquifer. University of Texas at Austin Center for Research in Water Resources Technical Report 269.

Booth, D. B. 1990. Stream channel incision following drainage basin urbanization. Water Resources Bulletin 26:407-417.

Booth, D. B. and L. E. Reinelt. 1993. Consequences of urbanization on aquatic systems – measured effects, degradation thresholds, and corrective strategies. Pages 545-550 *in* Proceedings of the Watershed '93 Conference.

Brune, G. 1975. Major and Historical Springs of Texas. Texas Water Development Board Report 189. Pg. 32. Austin, Texas.

Brune, G. 1981. Springs of Texas, Volume I. Pgs 67-69. Branch-Smith, Inc. Fort Worth, Texas.

Burton, G. and C. Ingersoll. 1994. Evaluating the toxicity of sediments. *In* The ARCS Assessment Guidance Document. EPA/905-B94/002. Chicago, Illinois.

Dartiguenave, C. M., I. ECLille, and D. R. Maidment. 1997. Water quality master planning for Austin, Texas. University of Texas at Austin Center for Research in Water Resources Online Report 97-6.

Chippindale, P., A. Price, J. Weins, and D. Hillis. 2000. Phylogenetic relationships and systematic revision of central Texas hemidactyline plethodontid salamanders. Herpetological Monographs 14:1-80.

City of Austin. 1990. Stormwater pollutant loading characteristics for various land uses in the Austin area. Austin, Texas, USA.

City of Austin. 1998. A 319 nonpoint source grant project - urban control technologies for contaminated sediments. City of Austin, Drainage Utility Department, Environmental Resources Management Division. Water Quality Report Series City of Austin-ERM/ 1998. Austin, Texas.

Hammer, T. R. Stream channel enlargement due to urbanization. 1972. Water Resources Research 8:1530-1540.

Harfenist, A., T. Power, K. Clark, and D. Peakall. 1989. A review and evaluation of the amphibian toxicological literature. Technical Report No. 61. Canadian Wildlife Service. Ottawa, Canada.

HDR Engineering, Inc. 2000. Brazos G Region Water Plan; Initially Prepared Regional Water Plan. Pgs. ES8-ES10.

Klein, R.D. 1979. Urbanization and stream quality impairment. Water Resources Bulletin 15(4): 948-963.

Mayer, F. and M. Ellersieck. 1986. Manual of acute toxicity: Interpretation and data base for 410 chemicals and 66 species of freshwater animals. U.S. Fish and Wildlife Service Resource Publication 160. Washington, D.C.

Petranka, J.W. 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington D.C.

Phipps, G., V. Mattson and G. Ankley. 1995. The relative sensitivity of three freshwater benthic macroinvertebrates to ten contaminants. Arch. Environ. Contam. Toxicol. 28:281-286.

Pizzuto, J. E., W. C. Hession, and M. McBride. 2000. Comparing gravel-bed rivers in paired urban and rural catchments of southeastern Pennsylvania. Geology 28:79-82.

Price, A., P. Chippindale, and D. Hillis. 1994. Relationships, status, and distribution of central Texas hemidactyliine plethodontid salamanders (*Eurycea* and *Typhlomolge*). Final section 6 report, part II, project 3.4, grant no. E-1-4. Funded by U.S. Fish and Wildlife Service and Texas Parks and Wildlife Department under section 6 of the Endangered Species Act. Austin, Texas.

Schueler, T.R. 1991. Mitigating the adverse impacts of urbanization on streams: A comprehensive strategy for local government. Pages 114-123 *in* Nonpoint Source Watershed Workshop: Nonpoint Source Solutions. Environmental Protection Agency Seminar Publication EPA/625/4-91/027. Washington, D.C.

Schueler, T. R. 1994. The importance of imperviousness. Watershed protection techniques, Volume One. Center for Watershed Protection. Silver Spring, Maryland, USA.

Texas State Data Center. 2000. Projections of the population of Texas and counties in Texas by age, sex, and race/ethnicity for 1990-2030. Produced by Texas Agricultural Experiment Station, Texas A&M University. College Station, Texas.

U.S. Fish and Wildlife Service. 2005. Barton Springs Salamander (*Eurycea sosorum*) Recovery Plan. U.S. Fish and Wildlife Service, Albuquerque, NM.

APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve: /s/ Rich McDonald 1/17/2005
Acting Regional Director, Fish and Wildlife Service Date

Concur: August 23, 2006
Director, Fish and Wildlife Service Date

Do not concur:
Director, Fish and Wildlife Service Date

Date of annual review: October 7, 2005
Conducted by: Paige Najvar, Austin Ecological Services Field Office